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## TASK 27

### BUILDING ENVELOPE COMPONENTS

*Performance, durability and sustainability  
of advanced windows and solar components  
for building envelopes*

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Annex  
October 1999



## 1. Description of technical sector

For the purposes of this Task, solar building envelope components are defined as clear, translucent and solar control media for building windows and facades, dynamic glazings and solar collectors and their integration into functional facade elements. The Task identifies some important components which can make a significant contribution to promoting the further development, uptake and integration of energy efficient products in the envelope of solar buildings. The work addresses specific fundamental problems and knowledge dissemination issues necessary to provide improved knowledge of solar, visual and thermal performance and to increase confidence in the selection and use of new products through increased understanding of performance, durability, reliability and environmental quality.

The solar building envelope components that will be considered for work in this Task will be selected from the following:

- Coated glass products
- Edge sealed glazings, windows and solar façade elements
- Dynamic glazing i.e. electrochromic, gasochromic and thermochromic devices, thermotropic and other dispersed media
- Antireflective glazing
- Light diffusing glazing
- Vacuum glazing
- Transparent insulation materials
- Daylighting products
- Solar protection devices, e.g. blinds
- PV windows
- Solar collector materials including polymeric glazing, polymeric absorbers and reflectors.

The Task will build on the work of Task 18, Advanced Glazing Materials, and of the Materials in Solar Thermal Collectors Working Group. The Task will emphasise performance assessment methodologies to enable comparison and selection of different products, estimation of energy and indoor climate performance and required performance criteria to aid the development, uptake and integration of advanced technologies within the building envelope.

The emphasis will be on near market technology, but future developments which may be more remote from application will not be excluded. The selection of materials and components to be investigated will be determined in part through industrial collaboration and participation in the Task.

Participants to Task 27 will include materials scientists, physicists, chemists, mechanical engineers, design engineers, manufacturers, specifiers and industry representatives. Coordination with other Tasks of the IEA Solar Heating and

Cooling Programme, IEA Building and Community Systems and IEA Photovoltaic Power Systems will take place as appropriate.

## 2. Objectives

The objectives of this Task are to determine the solar visual and thermal performance of materials and components, such as advanced glazing, for use in more energy efficient, comfortable, sustainable buildings, on the basis of an application oriented energy performance assessment methodology; and to promote increased confidence in the use of these products by developing and applying appropriate methods for assessment of durability, reliability and environmental impact.

## 3. Means

(a) The objectives shall be achieved by the participants in the following Subtasks:

- Subtask A: Performance (Subtask Leader: Dick van Dijk, TNO, Netherlands)
- Subtask B: Durability (Subtask Leader: Bo Carlsson, SP, Sweden)
- Subtask C: Sustainability (Subtask Leader: Jean-Luc Chevalier, CSTB, France)

### (1) **Subtask A: Performance**

The objective of Subtask A is to further develop, structure and integrate the energy performance assessment methodology for windows and other solar building envelope components. Such a methodology will facilitate selection of components and enable comparative performance to be made. Particular emphasis will be given to the assembly and integration of high performance, novel and/or complex solar components into functional building envelope elements. Those assemblies may incorporate highly insulating glazings/frames, anti-reflecting or chromogenic switchable glazings, PV windows, solar shading devices and other daylight components. Data realised by the Subtask will be provided in consistent and harmonised forms suitable for use for product comparison and selection and in building simulation tools. This work will also enable cost benefit studies to be performed and performance criteria to be defined for the work of Subtask B. The work will directly support manufacturers in improving product characterisation and specification.

The main activities in Subtask A are:

- (a) Evaluation of the state-of-the-art of energy performance assessment in different participating countries and international standardisation

Solar, optical/visual and thermal performance properties of materials and building envelope components and their integration into assemblies will be defined which are relevant for the energy and daylight performance of a product or integrated assembly, and for the assessment of the impact of material degradation or component failure on the performance over time.

(b) Assessment of performance in real use and for characterisation.

Test conditions for measurement of the performance parameters of components will be determined and measurements will be made on materials and complete components. Physical models will be further developed that will allow prediction of the performance of components from material properties. The ultimate goal is to achieve coherent sets of widely applicable calculation methods supported by simple test methods. In this context, recommendations for standard calculation and test methods will be made to support work on international standards.

(c) Development of a structured data base of components and systems.

Product and component data have to be made available in consistent and harmonised forms, suitable for product comparison and selection and for simulation of performance in specific applications. The structured data base will comprise the range from certified data of established high performance products to results from research on prototypes of novel materials and products.

## (2) **Subtask B: Durability**

The objectives of this subtask are to develop a general framework for durability test procedures and service lifetime prediction (SLP) methods that are applicable to a wide variety of advanced optical materials and components used in Energy Efficient Solar Buildings applications, and to apply the appropriate durability test tools to specific materials / components to allow prediction of service lifetime and to generate proposals for international standards.

The main activities in Subtask B are:

(a) Durability assessment methodology

A review of existing durability test procedures and SLP methodologies will be performed. A general outline of methodologies applicable to a variety of specific materials (leading to individual projects) will be drafted. The general approach will be adapted to these specific materials and components. Standardised analysis and

testing protocol tools will also be developed throughout this process. These will include standardised data formats, data base structures, and computer algorithms for data analysis, along with hardware instrumentation specifications for monitoring and measurement.

(b) Applications of durability test methods

The list of materials to which the generic methodology will be adapted may include anti-reflective (AR) glazings, thermotropic coatings, electrochromic materials, gasochromic materials, reflectors, polymeric glazings, polymeric absorbers, transmitting insulation materials (TIM), facades, daylighting materials, solar shading materials, windows, and low-e coatings.

### (3) **Subtask C: Sustainability**

The objectives of Subtask C are investigating and identifying relevant methodologies and criteria in two of the main fields of sustainability: environmental impact assessment and service life prediction.

The main activities in Subtask C are:

- (a) Review of internationally agreed sustainability indexes.
- (b) Existing knowledge about environmental impact assessment within the participating countries will be collected regarding tools available (LCA and simplified tools), studies already performed, national actions and priorities and needs expressed by the industry, and a harmonised format for communication on environmental characteristics will be developed.
- (c) Demonstration of the applicability of the methodology by applying it to three examples (comparison between an advanced and a traditional double glazing unit, sensitivity study on a solar collector).
- (d) Risk analysis (tools) includes the estimation of the service life time based on the durability approach developed on the material level and the assessment of catastrophic failures of advanced products at the component scale.
- (e) The application of the Failure Mode Effects and Analysis, which will be adapted to windows and solar devices allows the identification of premature termination possibilities of the predicted service life of components.

#### (b) Subtask Leaders

A Subtask Leader for each of the foregoing Subtasks will

- (1) Co-ordinate the work performed under that Subtask;
- (2) Assist the Operating agent in preparing the detailed Programme of Work;
- (3) Direct technical workshops and provide the Operating Agent with written summaries of workshops results; and
- (4) Edit technical reports resulting from the Subtask and organize their publications.

The Subtask Leader shall be a Participant who provides to the Subtask a high level of expertise and undertakes substantial research and development in the field of the Subtask. The Subtask Leaders shall be proposed by the Operating Agent, and designated by the Executive Committee, acting on unanimity of the Participants. Changes in the Subtask Leaders may be agreed to by the Executive Committee, acting on unanimity of the Participants.





## (c) Technical Advisory Committee

The Participants shall establish a Technical Advisory Committee consisting of the Subtask Leaders and the Operating Agent or their respective designees. The Technical Advisory Committee shall assist the Operating Agent in the co-ordination of the Task and advise the Operating Agent on the performance of the task.

## 4. Results

The products of work performed in this Annex are designed for the glazing and building industry (manufacturers of components and systems) and the solar industry (manufacturers of components and systems), for users such as architects, civil engineers and planners, and finally, for the end-users such as owners of buildings.

Results of the activity will include

Subtask A:

- (a) A further developed coherent energy performance assessment methodology to enable comparison and selection of different products and to provide guidance for their assembly and integration into building envelope elements.
- (b) A structured data base of components and façade elements to present data in a consistent and harmonised form, suitable for product comparison and selection and for simulation of performance in specific applications.
- (c) Recommended calculation and test methods for solar and thermal performance parameters in support of international standards development.

Subtask B:

- (a) A validated methodology for durability assessment of advanced solar building materials.
- (b) A prediction of the service lifetime based on degradation of performance for each of the materials tested.
- (c) Recommended standard test procedures for service life testing of selected materials and components.

Subtask C:

- (a) A review of international knowledge base, tools, actions and requirements related to glazing, windows and solar components.
- (b) An overview of the FMEA tool capabilities, adaptation to the field of glazing, windows and solar components, and guidelines for using it in the assessment of possible shortening/reduction of the service life.

## 5. Time schedule

This Task shall enter into force on 1st January 2000 and shall remain in force until 31st December 2003.

Within the limits of the term of the agreement this Annex may be extended by agreement of two or more participants acting in the Executive Committee and shall thereafter apply only to those participants.

## 6. Specific Obligations and Responsibilities of the Participants

In addition to the obligations enumerated in Article 7 of this Agreement

- (a) Each Participant shall provide the Operating Agent with detailed reports on the results of the work carried out in each Subtask,
- (b) Each Participant shall collect, assess and report to the Operating Agent data on solar building envelope components; and
- (c) Each Participant shall participate in the editing and reviewing of draft reports of the Task and Subtasks.

## 7. Specific Obligations and Responsibilities of the Operating Agent

(a) In addition to the obligations enumerated in Articles 4 and 7 of this Agreement, the Operating Agent shall

- (1) Prepare and distribute the results described in paragraph 6 above;
- (2) Prepare joint assessments of research development and demonstration priorities for Building envelope components;
- (3) At the request of the Executive Committee organize workshops, seminars, conferences and other meetings;
- (4) Prepare the detailed Programme of Work for the Task in consultation with the Subtask Leaders and the Participants and submit the Programme of Work for approval to the Executive Committee;
- (5) Propose and maintain a methodology and a format for the submission of information on solar assisted cooling systems which is collected by the Participants as described in paragraph 3 above;

- (6) Provide, at least semi-annually, periodic reports to the Executive Committee on the progress and the results of the work performed under the Programme of Work;
  - (7) Provide to the Executive Committee, within six months after completion of all work under the Task, a final report for its approval and transmittal to the Agency;
  - (8) In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programmes and projects implemented by or under the auspices of the Agency or by other competent bodies;
  - (9) Provide the Participants with the necessary guidelines for the work they carry out with minimum duplication;
  - (10) Perform such additional services and actions as may be decided by the Executive Committee, acting by unanimity.
- (b) The Operating Agent shall be responsible for any damage to persons or property and for all legal liabilities, actions, claims, costs and expenses connected therewith to the extent described in Article 8 (c) of this Agreement.

## 8. Meetings

Experts meetings of the Task will be carried out at intervals of approximately 6 months. Subtask leaders may arrange meetings in between or in association with Experts meetings of the Task. Attendance at the Experts meetings of the Task will be mandatory.

## 9. Funding

Each country will bear the costs of its own participation in the Task, including necessary travel costs, as well as a contribution to a common Task output (design handbook, CD-ROM, presentation at a major trade fair). The cost of organizing meetings will be borne by the host country.

## 10. Level of effort

The Participants agree on the following funding commitment:

- (a) Each Participant (country) will contribute to this Task a minimum of 0.5 person year per year of the Task, i.e. a total of 2 person years;
- (b) Participation in the Task requires participation in at least one of the Subtasks A, B, C.
- (c) The Operating Agent will contribute with a minimum of 0.4 person year per year to the Task; and

- (d) In addition to the specific obligations, the Operating Agent will produce, promote and distribute the results of the Task. The costs of these activities are estimated as US\$ 30,000, to be equally shared by all participating countries.

Participation may partly involve funding already allocated to a national (or international) activity which is substantially in agreement with the scope of work outlined in this Annex. Aside from providing the resources required for performing the work of the Subtasks in which they are participating, all Participants are required to commit the resources necessary for activities which are specifically collaborative in nature and which would not be part of activities funded by national or international sources. Examples include the preparation for and participation in Task meetings, co-ordination with Subtask Participants, contribution to the documentation and dissemination work and Task related R&D work which exceeds the R&D work carried out in the framework of the national (or international) activity.

## 11. Operating agent

The Federal Republic of Germany, acting through Michael Köhl, is designated as Operating Agent.

## 12. Information and intellectual property

For purposes of this Annex, the following provisions shall apply in addition to the intellectual property provisions contained in Article 7 of the Agreement:

- (a) For arising information regarding inventions the following rules shall apply:
- (1) Arising information regarding inventions shall be owned in all countries by the inventing Participant. The inventing Participant shall promptly identify and report to the Executive Committee any such information along with an indication whether and in which countries the inventing Participant intends to file patent applications;
  - (2) Information regarding inventions on which the inventing Participant intends to obtain a patent protection shall not be published or publicly disclosed by the Operating Agent or the other Participants until a patent has been filed, provided, however, that this restriction on publication or disclosure shall not extend beyond twelve months from the date of reporting of the invention. It shall be the responsibility of the inventing Participants to appropriately mark Task reports which disclose inventions that have not been appropriately protected by filing a patent application.
- (b) The inventing Participant shall license proprietary information arising from the Task for non-exclusive use as follows:
- (1) To Participants in the Task:

- (a) On the most favourable terms and conditions for use by the Participants in their own country; and
  - (b) On favourable terms and conditions for the purpose of sub-licensing others for use in their own country.
- (2) Subject to sub-paragraph (1) above, to each Participant in the Task for use in all countries, on reasonable terms and conditions; and
- (3) To the government of any Agency Member country and nationals designated by it, for use in such country in order to meet its energy needs.
- Royalties, if any, under licenses pursuant to this paragraph shall be the property of the inventing Participant.

### 13. Participants in this Task

The Contracting Parties which are Participants in this Task and their delegates are the following:

Australia ?  
 Austria  
 Belgium ?  
 Canada  
 Denmark  
 Finland  
 France  
 Germany  
 Italy  
 Japan  
 Netherlands  
 Sweden  
 Switzerland  
 United Kingdom  
 United States of America

The following country will participate as an observer in the beginning of the Task. If they can achieve a commitment of a formal participation in the Agreement, they will enter the Task as full participants:

Slovenia (Observer)